Space Weather Technical Forecast

Issued on Monday, 14 August 2023 at 01:25 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/Minor Storm, mainly day 2 (15 Aug). Chance of isolated M-flares (R1 Blackouts).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with peak flare C2.5 from AR3395 at 13/0953 UTC. This is a small, and weakening sunspot region on the northwest disc, with component delta spot gradually dissipating. Of the six numbered regions on the disc, the main development was AR3403 in the northeast. This rapidly grew to a moderately sized region, with ongoing consolidation of its small spots into a larger but simple bipolar configuration. AR3397 in the northwest also settled into a simple and stable bipolar configuration, while mature AR3394 is now approaching the southwest limb and persisting as a stable unipolar spot. There were no Earth-directed CMEs.

Solar Wind / Geomagnetic Activity: Slow wind conditions observed by ACE at L1 with wind speeds easing to background, from 400 km/s to around 350 km/s. Density remained below average. Total interplanetary magnetic field (IMF) Bt, was weak, below 6nT, with north-south component, Bz, varying between -4 nT and +5nT. Phi angle was predominately negative (towards the Sun). Geomagnetic activity was Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux has remained at background levels. GOES16 High energy (greater than 2MeV) electron flux varied between background and high levels with the diurnal cycle, peaking 1370 pfu at 13/1530 UTC. A slower decline was observed than recent days, however. The associated 24-hour integrated fluence remained below Active (1e8 integrated pfu), but with a rising trend, reaching 5.91e7 integrated pfu at 14/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Mainly Low activity is expected, but with a daily chance of rising to Moderate with isolated M-flares.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. CH33/+ fast winds are anticipated to arrive either later day 1 or more likely day 2 (14-15 Aug), with solar winds likely rising to around 500-600km/s. Further enhancements are possible day 3 (16 Aug) from CH35/-, however this is low confidence. Initially Quiet geomagnetic activity is expected to become Unsettled to Active with a likelihood of G1/Minor Storm intervals, either late day 1 or day 2 (14-15 Aug). Activity then easing to Unsettled to Active, but with an ongoing slight chance of G1 Minor Storm intervals day 3 and 4 (16-17 Aug).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is expected to persist at background. High energy electron flux (greater than 2MeV) is forecast to continue varying between Background and High, but with an increasing trend over previous days, before dropping out in response to any fast wind arrival later day 1 or day 2 (14-15 Aug). A more persistent recovery to Moderate to High values is then expected follow, however the timing of this flux being observed at GEO is low confidence. Fluence will rise in response, giving a chance of reaching Active, mainly day 3-4 (16-17 Aug).

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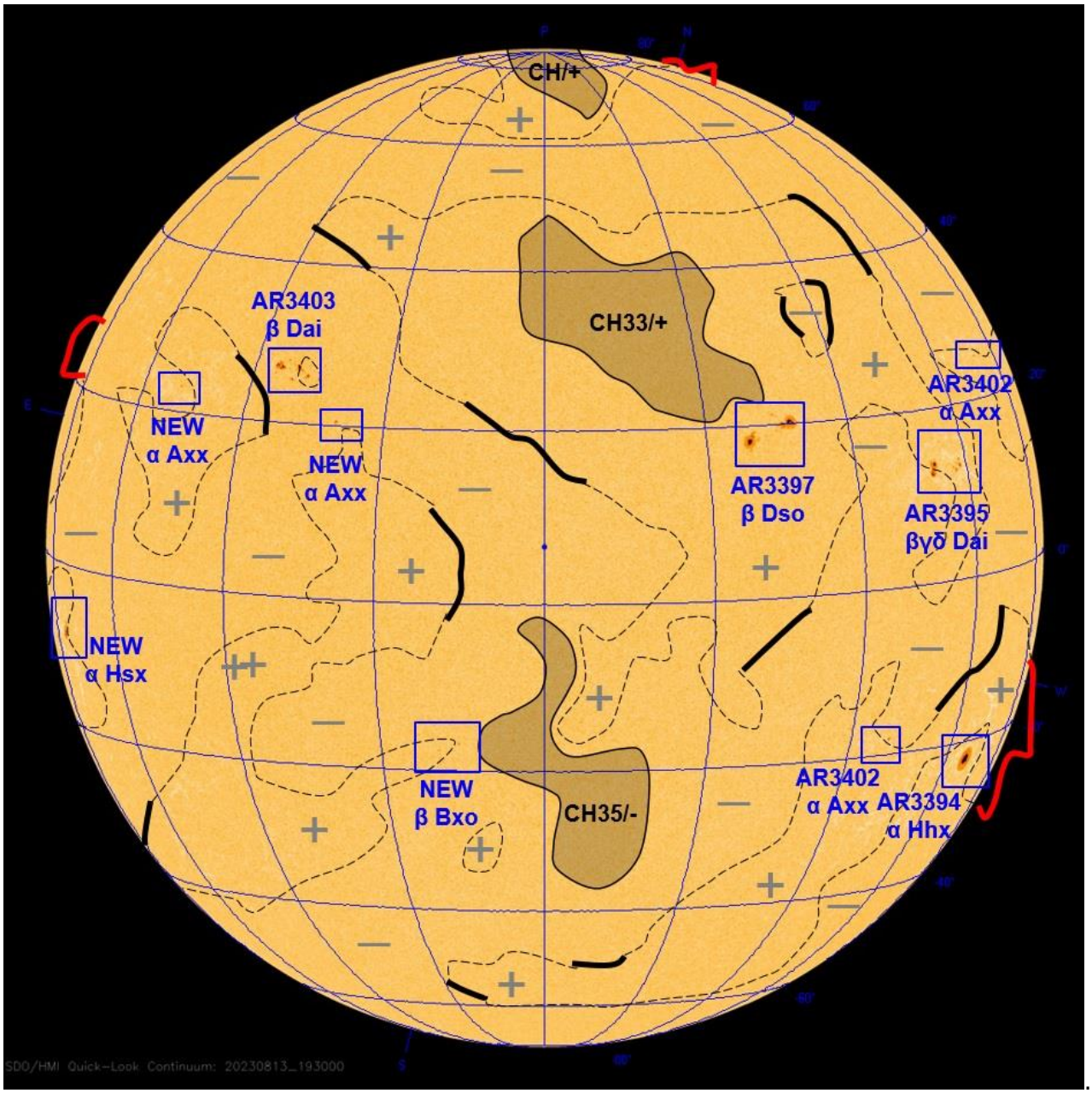
Figure 1. Solar Analysis Valid *.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no Earth-directed CMEs.

Current slow wind conditions are forecast to increase later day 1 (14 Aug) and more likely during day 2 (15 Aug). This is due to the onset of fast winds from CH33/+ in the northern disc, along with any preceding CIR. As a positive polarity coronal hole, there is a higher chance of a geoeffective connection at this time of year (Russel-McPherron effect). This is also a later onset than MOSWOC enlil indicates, as the model appears to be also generating a high speed stream from an area of weak fields currently in the west centre disc which is currently considered as only having a low chance of occurring earlier on day 1 (14 Aug).

CH35/- on the southern disc has a less certain influence on the expected solar wind conditions, due its negative polarity, and with Earth currently above the ecliptic. This may prolong elevated solar winds into day 3 (16 Aug), but with a lower likelihood of significantly enhanced geomagnetic activity. A gradual easing of winds is then expected day 4 (17 Aug).

Initially Quiet activity is expected to become Unsettled to Active with a likelihood of G1/Minor Storm intervals, either late day 1 or day 2 (14-15 Aug). Activity then easing to Unsettled to Active, but with an ongoing slight chance of G1 Minor Storm intervals day 3 and 4 (16-17 Aug).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	60	20	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2a: SDO aia-193 and 211 showing northern and southern coronal holes

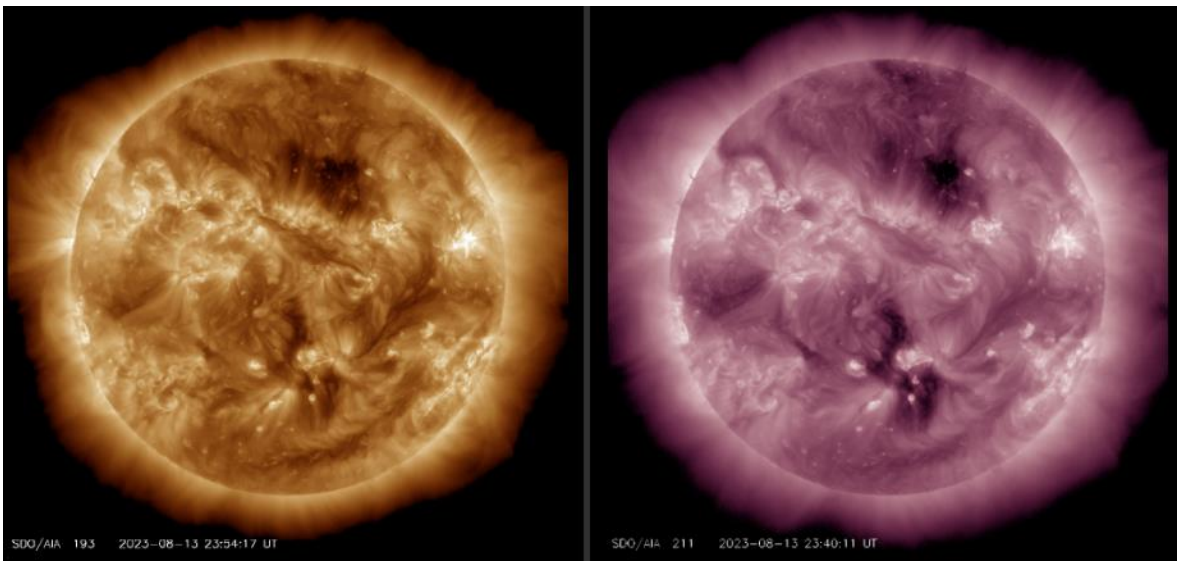

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Figure 2b: Enlil with earlier arrival. This has not been observed, and is likely due to an incorrect analysis of a central coronal hole on 11 Aug.

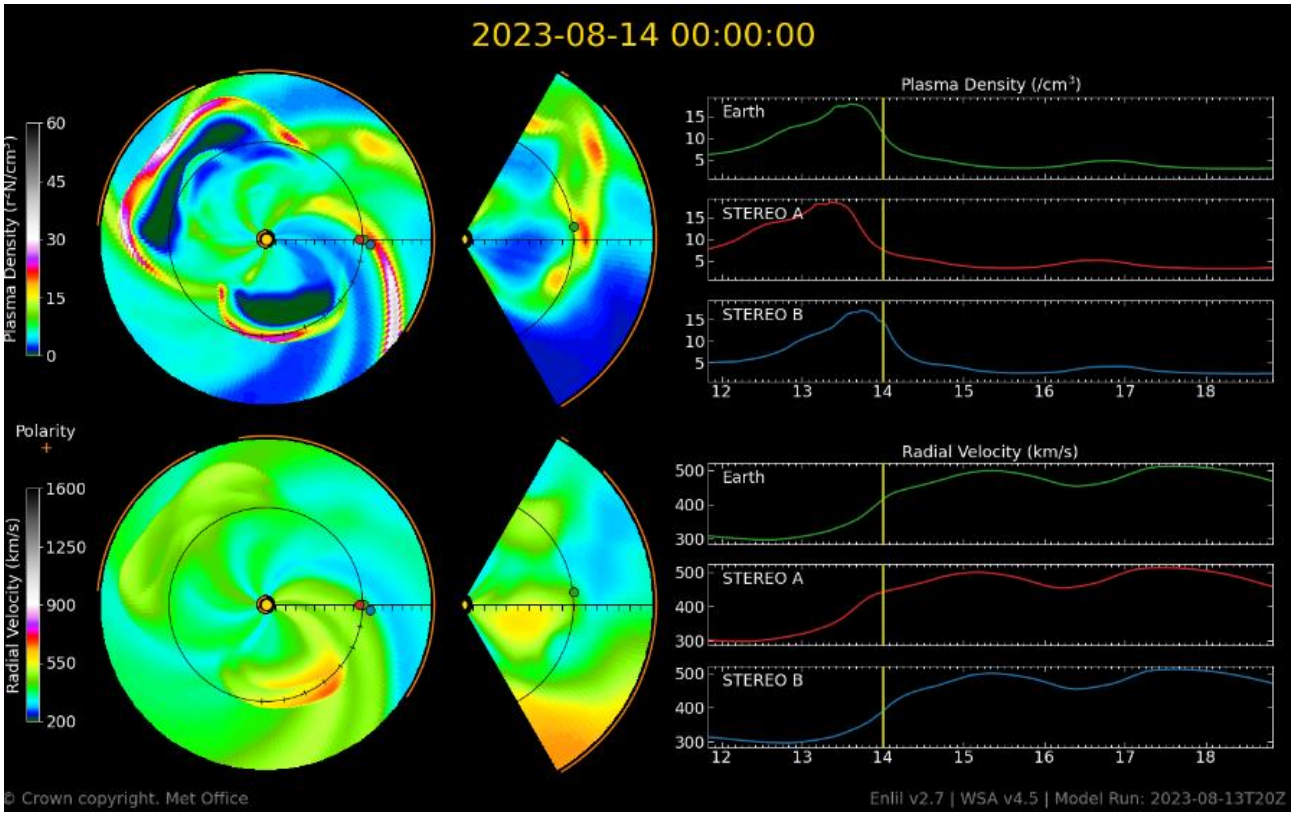
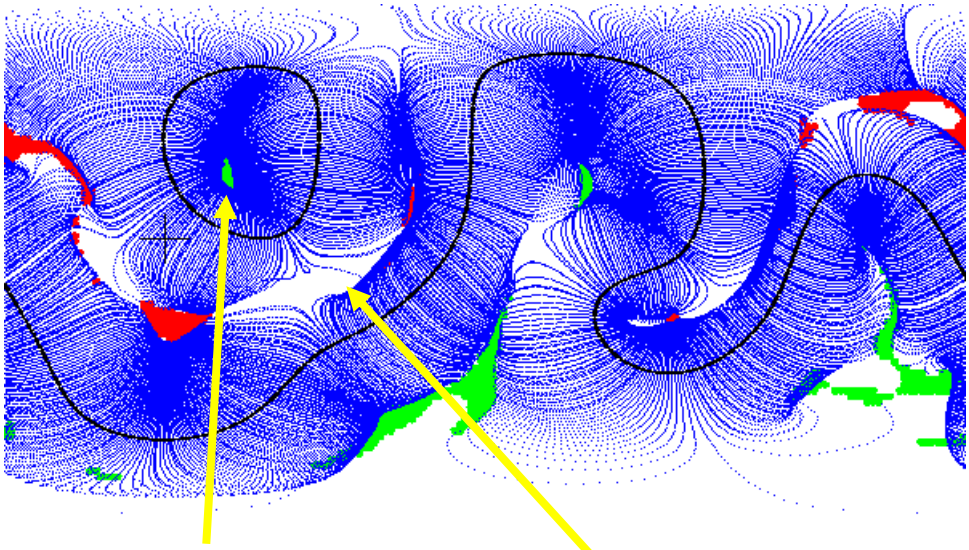


Figure 2b: GONG PFSS Model Data (Similar to Enlil boundary conditions) Earth is indicated by cross, and current solar winds are sourced from the region to the right of this. Blue lines show the field lines, with fast wind from open field, slow wind from closed field



CH33/+ looks under-represented in the PFSS field with larger CH here. Will likely be stronger in reality.

This open field negative area, with weak CH is likely source of enhancement Enlil is indicating, and the region Earth would currently be connected to. Not expected to be as strong

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Radio Blackouts - X-Ray Flares:

Solar activity is currently Low with six numbered sunspot regions and two further small unnumbered regions. There remains a chance of isolated M-flares.

The most active region on the disc is AR3395. This is a magnetically complex, but small and weakening region. A number of small delta spots were present in the disc, however these have now largely dissipated with only C-flares observed as this occurred. AR3403 in the northeast is now the main flare risk on the disc, having rapidly developed in the last 24 hours. However this region remains relatively simple with a straightforward bipolar magnetic configuration. The other numbered regions of note included AR3397 in the northwest has also developed into a simple bipolar spot, and AR3394, currently the largest spot on the disc and is now approaching the southwest limb as a mature and stable region. The other regions on the disc are small, simple and unlikely to produce notable flares.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	30	40	40	40
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES-16/ X-ray Flux

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Solar Radiation Storms - (High Energy Protons):

The flux of high energy (greater than 10 MeV) is at background. The sunspots on the visible disc, including those on the western hemisphere, are currently relatively simple and currently considered unlikely to produce proton events. Barring any further development of these, the proton flux is expected to remain at background.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	2	2	2
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux at GOES-16 has been varying between background and diurnal peaks of high (above 1000 pfu). As solar winds have eased, the observed minimum value has tended upwards, resulting in the associated 24 hour fluence also having a gradual increasing trend. The arrival of the next fast wind on the day 1, or more likely day 2 (14-15 Aug) will lead to the flux dropping out, before a more persistent rise is expected day 3 (onward).

The associated fluence is expected to approach the Active (1e8 integrated) threshold on day 1 (15 Aug), but most likely staying below, before falling day 2 (15 Aug) as a result of the flux dropping out with any HSS arrival. Day 3 and 4 will then see fluence rising again, with an increasing risk of reaching Active. This is low confidence however, with further solar wind enhancement possible day 3 (16 Aug). REFM is currently giving poor guidance with a decreasing trend indicated, however a rising or steady trend is considered most likely.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	10	10	30	40
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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Figure 4: GOES-16 >2MeV Electron Flux and Fluence with REFM

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